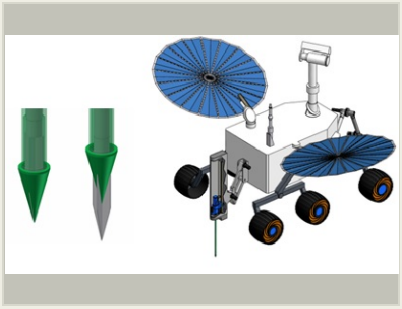
The Stinger: A Geotechnical Sensing Package for Robotic Scouting on a Small Planetary Rover, Phase I

Completed Technology Project (2016 - 2016)

Project Introduction

Flawless operation of planetary mobility systems, excavation, mining and ISRU operations, regolith transport and many others depend on knowledge of geotechnical properties of the soil. Knowing, for example, the soil strength and its density and in turn fundamental soil parameters such as friction angle and apparent or true cohesion, will guide the design of the wheels and excavation systems and help to determine anticipated excavation energies, time, and forces. Nearly all planetary rovers to-date have experienced some type of problem due to the unknown nature of planetary regolith. The MER Spirit mission ended when the rover bogged down. The MER Opportunity rover barely recovered from a sand trap. MSL Curiosity spent over a month trying to find a safer route around a sand dune. Apollo Lunar Roving Vehicle got stuck and had to be lifted and placed on firmer ground while Lunokhod managed to recover from a 'near' stuck position. Honey Robotics, therefore, proposes to design and test a prototype geotechnical tool called the Stinger, that combines soil bearing strength measurements with shear test measurements. The Stinger instrument consists of a percussive cone shear-vane penetrometer capable of measuring near-surface and subsurface soil properties to a depth of 50 cm or greater. The cone deployment is percussive, because this approach reduces penetration forces, an important consideration when a tool is deployed in a low gravity environment from a small vehicle. During percussive cone deployment, the soil bearing strength is measured. The shear vane is initially housed inside a cone and it is pushed out whenever shear tests are required. When the shear vane is out, the cone-vane is rotated to measure shear strength of the soil. This measurement can be performed at any depth. Based on results of the breadboard testing, a preliminary design for a TRL6 Stinger GeoTool will also be realized.



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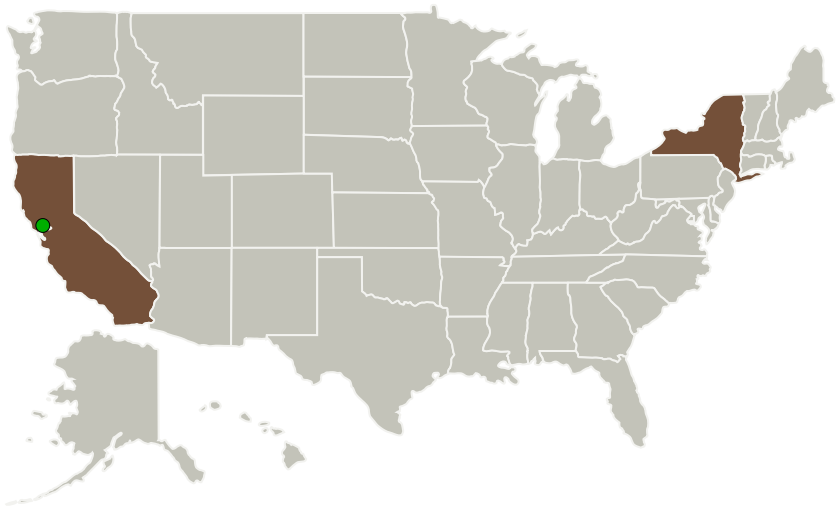
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Honeybee Robotics, Ltd.	Lead Organization	Industry	Pasadena, California
Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California

Primary U.S. Work Locations	
California	New York

Project Transitions

June 2016: Project Start

December 2016: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141024)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Honeybee Robotics, Ltd.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

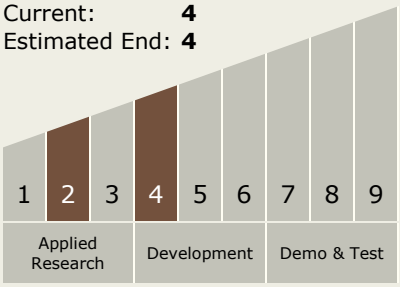
Carlos Torrez

Principal Investigator:

Kris Zacny

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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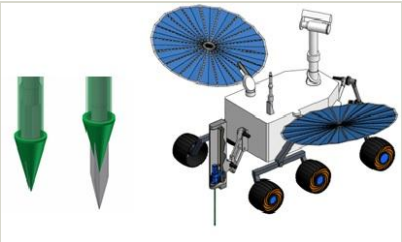
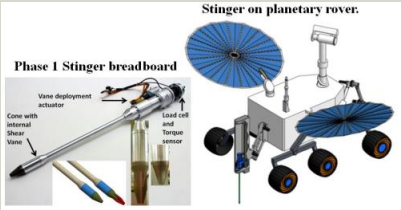
Images



Briefing Chart Image
The Stinger: A Geotechnical Sensing Package for Robotic Scouting on a Small Planetary Rover, Phase I
(https://techport.nasa.gov/image/128531)



Final Summary Chart Image
The Stinger: A Geotechnical Sensing Package for Robotic Scouting on a Small Planetary Rover, Phase I Project Image
(https://techport.nasa.gov/image/133621)

Technology Areas

Primary:

- TX04 Robotic Systems
  - TX04.3 Manipulation
    - TX04.3.2 Grappling Technologies

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System